SORTING SYSTEM USING A ROLLER-TOP CONVEYOR BELT

DESCRIPTION

Background

[Para 1] The invention relates generally to power-driven conveyors and, more particularly, to sorting systems using roller-top conveyor belts to divert articles from one side or the other of a main conveyor.

[Para 2] In the tire industry, finished tires leave the inspection area in a mix of various types and sizes. Usually the tires are sorted automatically, using bar codes or colored line codes to designate type or size. Transported on a sorting conveyor, the tires are identified by a bar code or color code reader, or sometimes even by a human operator that recognizes the tire type and pushes the appropriate identification button. As soon as an identified tire passes the proper exit of the sorter conveyor for that type of tire, the tire is moved sideways at a 90° angle onto an exit conveyor that conveys the tire to the proper palletizing or storage station. Classical sorting systems use a complex set up of narrow belts and pop-up driven rollers to make the 90° diversion.

[Para 3] Several conventional sorting systems use transverse-roller-top belts in line with a main conveyor. Simple pneumatic or electric pushers push an identified tire off the side of the transverse-roller-top belt onto an exit conveyor. A disadvantage of this system is that it is difficult to transfer tires onto exit conveyors when they are positioned opposite each other across the main conveyor.

[Para 4] Thus, there is a need for a less complex sorting system for tires and other articles.

Summary

[Para 5] This need and other needs are satisfied by a conveyor system embodying features of the invention. In a first version, a conveyor system comprises a main conveyor that conveys articles on an outer conveying surface along a main conveying path. At least one cross conveyor is disposed along the conveying path. The cross conveyor, which intersects the main conveyor, includes a roller-top belt with rollers extending outward of an article-supporting surface of the belt. Axles allow the rollers to rotate about axes that are generally perpendicular to the main conveying path. A drive engages the roller-top belt to advance it along a discharge path generally perpendicular to the main conveying path.

[Para 6] A second version of conveyor system suitable for sorting conveyed articles comprises an upstream conveyor conveying articles along a main conveying path toward a downstream article receiver, which may be another conveyor. The article receiver is aligned with the upstream conveyor, but spaced apart from it along the main conveying path across a gap. A cross conveyor is disposed in the gap between the upstream conveyor and the downstream receiver. The cross conveyor includes a roller-top belt having rollers with axles for rotation of the rollers about axes generally perpendicular to the main conveying path. The cross conveyor also includes a drive that engages the roller-top belt to selectively stop and drive the roller-top belt bidirectionally.

[Para 7] In another aspect of the invention, a conveyor system comprises a downstream conveying surface and an upstream conveying

surface separated along a main conveying path by a gap. A cross conveyor in the gap includes a roller-top belt. Salient portions of rollers extend above a top side of the belt to contact conveyed articles received from the upstream conveying surface. Axles allow the rollers to rotate about axes generally perpendicular to the main conveying path.

[Para 8] According to yet another aspect of the invention, a conveyor system for selectively discharging articles comprises a main conveyor conveying articles along a main conveying path. The main conveyor is interrupted by one or more gaps along the main conveying path. One or more cross conveyors intersect the main conveying path at the gap. Each cross conveyor includes a roller-top belt, which has rollers arranged to rotate freely. Articles received from the main conveyor on the roller-top belt are rolled across the gap by the rollers in the direction of the main conveying path. A drive engages the roller-top belt to advance it across the main conveying path to divert articles from the main conveying path.

[Para 9] Another version of conveyor system comprises a main conveyor conveying articles along a main conveying path. One or more gaps along the main conveying path interrupt the main conveyor. A cross conveyor in each gap intersects the main conveying path with a roller-top belt. Rollers in the belt are arranged to receive conveyed articles in the gap from the main conveyor. The roller-top belt may be advanced in at least one direction across the main conveying path. The cross conveyor also includes means for raising and lowering the roller-top belt between a first position and a second higher position. In the first position, a conveyed article is supported by both the roller-top belt and the main conveyor. In the second position, the conveyed article is lifted by the roller-top belt out of contact with the main conveyor.

[Para 10] And, in still another aspect of the invention, a conveyor system comprises a main conveyor conveying articles along a main conveying path. At

least one gap interrupts the main conveyor along the main conveying path. A cross conveyor intersects the main conveying path at each gap. The cross conveyor includes a roller-top belt and a drive engaging the roller-top belt. Rollers in the belt are arranged to rotate freely to roll conveyed articles received from the main conveyor across the upstream end of the gap in the direction of the main conveying path. The drive engages the roller-top belt selectively to stop or advance the roller-top belt in either of two directions. While the belt is stopped, a conveyed article rides across the roller-top belt past the gap along the main conveying path. The drive may advance the roller-top belt in a first cross direction along a discharge path to divert a conveyed article from the main conveying path to a first side of the main conveying path. The drive may also advance the belt in an opposite second direction to divert a conveyed article to an opposite second side of the main conveying path.

Brief Description of the Drawings

[Para 11] These features and aspects of the invention, as well as its advantages, are better understood by referring to the following description, appended claims, and accompanying drawings, in which:

[Para 12] FIG. 1 is an isometric view of a portion of a sorting conveyor system embodying features of the invention;

[Para 13] FIG. 2 is a schematic top view of the conveyor system of FIG. 1;

[Para 14] FIG. 3 is a schematic side elevation view of the conveying system of FIG. 1;

[Para 15] FIG. 4A is a schematic front elevation view of a conveying system as in FIG. 1, showing the further feature of lifting and raising a cross conveyor, in a lowered position, and FIG. 4B is a schematic view as in FIG. 4A with the cross conveyor in a raised position; and

[Para 16] FIGS. 5A and 5B are schematic side elevation views of another version of conveying system embodying many of the features of FIG. 1 and illustrating the features of a single main conveyor belt and a lift for raising and lowering a cross conveyor relative to the main conveyor in a first lowered position and in a second raised position.

Detailed Description

[Para 17] A conveyor system embodying features of the invention is shown in FIG. 1. A main conveyor 10 defining a main conveying path 12 is interrupted by a gap 14. An upstream conveyor 16 is separated by the gap from a downstream conveyor 18 that receives conveyed articles, such as tires 20, from the upstream conveyor. Articles are conveyed along the main conveying path in the direction of arrows 22 on top article-conveying surfaces 24 of the conveyor. The main conveyor is preferably realized as a belt conveyor. In this example, the upstream conveyor includes a conveyor belt 26 looped around a drum or a sprocket set 28 mounted on a drive shaft 30. A drive motor 32, coupled to the shaft, rotates the sprocket set and drives the upstream belt in the direction of arrow 22. The other end of the upstream belt is looped around an idler shaft and sprocket set (not shown, but similar to that for the downstream conveyor to be discussed now). The downstream conveyor is also preferably a belt conveyor with an endless belt loop 27 extending from an idler sprocket set 29 or drum and shaft at the gap to a shaft and sprocket set at the other end (not shown, but it could include a drive motor as for the upstream conveyor belt). Instead of being separately driven by its own drive motor and shaft, the upstream conveyor can be slave-driven from the downstream conveyor through jackshafts, gears, or pulleys connected between the drive elements of the upstream and downstream conveyors. Although the upstream and downstream conveyors are preferably belt conveyors, they could alternatively be realized as driven-roller conveyors, vibrating conveyors, or drag-chain conveyors, for example.

[Para 18] A cross conveyor 34 is positioned in the gap 14 between the upstream 16 and downstream 18 portions of the main conveyor to serve as a sorting station. The cross conveyor includes a roller-top conveyor belt 36 wrapped around a drive sprocket set 38 on a drive shaft 40 driven by a motor 42 at one end and an idler sprocket set 39 on a shaft at the other end. The drive motor, shafts, and sprocket sets constitute a drive for the roller-top belt. Preferably, the drive is made bidirectional, as indicated by double-headed arrow 48, by using a reversing motor. Salient portions of rollers 50 extend outward from a top side 52 of the roller-top belt. The rollers are arranged to rotate about axes 54 that are generally perpendicular to the main conveying path 12. Axles 56 define the axes for the rollers and retain them in the belt. A wear surface 44 underlies the roller-top belt along the upper carryway portion of the cross conveyor belt's path 46. Conveyed articles can be diverted from the main conveyor along this discharge path in either of two opposite directions to other conveyors or receiving stations on opposite sides of the main conveying path. The drive can also stop the roller-top belt from advancing. When the roller-top belt is stopped, an article 20 is propelled by the upstream conveyor onto the rollers on the top article-supporting side of the roller-top belt. The rollers rotating freely as indicated by arrow 58 roll the article across the gap in the direction of the main conveying path onto the aligned downstream conveying portion of the main conveyor. As shown in FIG. 3, the article-conveying surfaces of the main conveyor at the gap lie in the same plane P as the top article-supporting side of the cross conveyor. In this way, the roller top belt serves as a low-friction bridge between the upstream and downstream conveying surfaces of the main conveyor.

[Para 19] To prevent articles from being stranded on the roller-top belt, the width W of the gap is preferably less than the dimensions D of the footprint of the articles being conveyed, as shown in FIG. 2. In the case of a tire, the critical dimension is its outer diameter. For articles having a more

complex shape, the critical dimension must be determined to prevent articles from being stranded.

[Para 20] Although the main conveyor may be realized by a variety of conveyors, the cross conveyor is realized as a roller-top belt conveyor. And, preferably, the roller-top belt is a modular plastic conveyor belt, such as the Series 400 Transverse Roller Top belt manufactured and sold by Intralox, L.L.C. of Harahan, Louisiana, USA. Modular plastic conveyor belts are constructed of rows of molded plastic belt modules connected end to end by hinge pins through interleaved hinge eyes between consecutive rows of belt modules. In the Intralox Series 400 roller-top belt, the rollers are plastic rollers with a central bore through which a stainless steel axle is received. The ends of the axle are embedded in the interior of the module and retain the roller rotatably in place in a module cavity. Although modular plastic conveyor belts are preferred, flat rubber or fabric belts may also be used in the invention.

[Para 21] When the cross conveyor is activated to divert articles off one side of the main conveyor or the other, it is undesirable for the conveyed article to be in contact with the article-conveying surface of the main conveyor as the article is being diverted. This is especially true in the case of articles made of high-friction materials, such as tire rubber. As shown in FIG. 4A, an article 20 conveyed along the main conveyor 10 transfers across the gap over the bridge formed by the roller-top belt 36. The sprocket sets 38, 39 about which the roller-top belt is looped are positioned on opposites sides of the main conveyor. When the roller-top belt is stopped, there is no pull, or tension, in the belt. The weight of the article transferred onto the roller-top belt causes it to sag until it lowers to a position to sit on a wear surface 44 (FIG. 1). As shown in FIG. 4B, when the belt is driven in either direction to divert articles off the main conveyor, the top article-supporting side of the cross conveyor belt rises from a first lower position 60′ to a second higher position 60. As the belt 36 is driven in either direction 48, belt pull, or tension, in the belt increases. The increased tension takes up the sag in the top

carryway portion of the belt and causes it to follow more closely a tangent line between the outer peripheries of the two sprockets 38, 39, which are elevated with respect to the plane P of the outer article-conveying surfaces of the main conveyor. Consequently, the cross conveyor belt is in a lower position to bridge the gap when the cross conveyor belt is not running and in a higher position lifting the conveyed article off the main conveyor when the cross conveyor belt is advancing to discharge articles off the side of the main conveyor. Thus, the elevated sprockets and the drive system constitute means for raising and lowering the roller-top belt.

[Para 22] FIGS. 5A and 5B show another version of the conveyor system with a differently configured main conveyor. In this version, the main conveyor is formed of a single conveyor belt 62 following an upper carryway path 64 and a lower returnway path 65. Conventional sprockets, rollers, and shoes (66, generally) are used to guide the main conveyor belt along its path. The top carryway portion of the main conveyor upstream of the gap 14 serves as an upstream conveyor, and the downstream top carryway serves as a downstream conveyor. In the gap, the main conveyor belt resides below the cross conveyor 34. In this way, a single belt with a single drive can be used in the main conveyor. The cross conveyor can be configured as in FIGS. 4A and 4B with the sprockets elevated to allow the cross conveyor belt to assume a lower position as in FIG. 5A to allow the article to transfer across the gap and stay on the main conveyor or a raised position as in FIG. 5B to divert articles off the main conveyor to either side of the belt without frictional contact with the main conveyor. A lift mechanism, indicated by arrow 67, and realized as a pneumatic or hydraulic piston, for example, could alternatively be used to actively raise and lower the cross conveyor relative to the main conveyor in coordination with the cross conveyor belt drive. As FIGS. 5A and 5B further show, a sensor 68 is positioned along the main conveying path to sense one or more characteristics of a conveyed article. For example, the sensor could be a proximity switch that detects the presence of an article approaching the gap by a signal sent over a signal line 70 to a controller 72, such as a

programmable logic control or other intelligent controller. The controller controls the activation of the cross conveyor drive to stop the cross conveyor belt or drive it in one of two opposite directions. The sensor or other sensors could also or alternatively be optical sensors, bar code readers, RFID sensors, or other sensing devices capable of sensing specific characteristics of the conveyed article to control the sorting of articles transferred onto the cross conveyor.

[Para 23] Although the invention has been described in detail with respect to a few preferred versions, other versions are possible. For example, the main conveyor may include more than one gap to allow for many cross conveyor sorting stations. As another example, if stranding is not a problem, the gap width need not be less than a critical dimension of the footprint of a conveyed article. And the cross conveyor need not be perpendicular to the main conveyor, but could define a discharge path at some oblique angle to the main conveying path. As yet another example, a stationary article receiving station can replace a downstream conveyor in receiving articles conveyed over the cross conveyor. Furthermore, to avoid the problem of friction by rubbing contact between a conveyed article and the main conveyor during article diversion, the main conveyor can include a roller-top belt with transverse rollers along which conveyed articles can roll as they are being discharged toward the side. So, as these few examples suggest, the scope of the claims is not meant to be limited to exemplary versions described in detail.